

UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Bertrand LEROUX, et al.
Application No.: 10/582,259
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Title: Staged Combustion Method Using a Low-Oxygen Gas
TC/A.U.: 3743
Examiner: Chuka Clement NDUBIZU
Docket No.: Serie 6439
Customer No.: 40582

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APPEAL BRIEF

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Sir:

This Brief is filed pursuant to the Notice of Appeal filed May 18, 2010.

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1. Real Parties In Interest

The real party in interest, L'AIR LIQUIDE, SOCIETE ANONYME A DIRCETOIRE ET CONSEIL DE SURVEILLANCE POUR L'ETUDE ET L'EXPLOITATION DES PROCEDES GEORGES CLAUDE, is the assignee of the entire title and interest in and to the subject application by virtue of an assignment recorded at the U.S. Patent and Trademark Office at: REEL/FAME 018916/0233.

2. Related Appeals and Interferences

There are no related Appeals or Interferences.

3. Status of Claims

Claims 16-21, 23-24, and 29-30 are on appeal. Each of these claims has been rejected. A complete copy of the current claims appears in the attached Appendix.

4. Status of Amendments

No After Final Amendments have been filed.

5. Summary of the Claimed Subject Matter

Claim 16 is directed to a method for the combustion of a fuel using an oxygenated gas, in which a jet of fuel and at least two jets of oxygen-rich oxygenated gas are injected. The first jet of oxygen-rich oxygenated gas, called the primary jet, is injected so as to be in contact with the jet of fuel and so as to generate incomplete first combustion. The gases output by this first combustion still include at least one portion of the fuel. The second jet of oxygen-rich oxygenated gas is injected at a distance ℓ_1 from the jet of fuel so as to combust with a first portion of the fuel present in the gases output by the first combustion. An oxygen-lean oxygenated gas is injected at a distance ℓ_2 from the jet of fuel so as to combust with a second portion of the fuel present in the gases output by the first combustion. The area of the cross section of the injection orifice for the oxygen-lean oxygenated gas is between 4 and 100 times the area of the injection cross section for the second jet of oxygen-rich oxygenated gas. The distance ℓ_2 is greater than ℓ_1 .

Claims 17-21 and 29-30 depend from claim 25 and thus include all of the limitations therein.

6. Grounds of Rejection to be Reviewed on Appeal:

The issues presented on Appeal are:

A. Whether claims 16-21, 23-24 and 29-30 are properly rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,910,879 (Dugue) in view of U.S. Patent No. 4,761,132 (Khinkis).

B. Whether claim 24 is properly rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,910,879 (Dugue) in view of U.S. Patent No. 4,761,132 (Khinkis) and further in view of U.S. Patent No. 5,759,022 (Koppang).

7. Arguments:

A) Claims 16-21, 23-24 And 29-30 Are Non-Obvious Over Dugue In View Of Khinkis.

Appellant makes three arguments. First, the Examiner's application of *In re Aller* may be distinguished and the Examiner's finding of facts underlying such application is not supported by substantial evidence. Second, the Examiner's rejection is not a successful showing under the teaching-suggestion-motivation (TSM) test or under other rationales identified by the Supreme Court in *KSR v. Teleflex*. Third, the modification of Dugue with the teachings of Khinkis suggested by the Examiner would not have resulted in the claimed subject matter.

1) The Examiner's Application Of *In re Aller* May Be Distinguished And The Examiner's Finding Of Facts Underlying Such Application Is Not Supported By Substantial Evidence.

The Examiner attempts to reject the claims as obvious with application of *In re Aller*. 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). However, the holding of *In re Aller* may be distinguished from the instant application. Additionally, the Examiner's application of *In re Aller* is predicated upon a finding of facts not supported by substantial evidence.

The U.S. Court of Customs and Patent Appeals held that "where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *Id.* at 456, at 235 (citing *In re Swain*, 156 F.2d 239, 33 C.C.P.A., Patents, 1250; *Minnesota Mining & Mfg. Co. v. Coe*, 69 App.D.C. 217, 99 F.2d 986; and *Allen v. Coe*, 77 U.S.App.D. C. 324, 135 F.2d 11). In *Aller*, the claims differed from the prior art in that the recited temperature and concentration differed from those of the prior art in only a small degree. That set of facts and associated holding may be distinguished from the claims of the instant application because Dugue fails to disclose the general conditions of the claims.

The Examiner recognizes that Dugue does not explicitly disclose that “the area of the cross section of the injection orifice for the oxygen-lean oxygenated gas is between 4 and 100 times the area of the injection cross section for the second jet of oxygen-rich oxygenated gas” as required by the claims. In order to address this deficiency of Dugue, the Examiner’s finding of facts relies upon several portions of Dugue in an attempt to show that it discloses the general conditions of the claimed subject matter. However, the Examiner’s finding of facts is based upon flawed math.

In particular, the Examiner refers to FIG 3B, column 3, lines 5-45, and column 5, lines 16-26 of Dugue to explain that the area of the cross section of the injection orifice for the oxygen-lean oxygenated gas is larger than that of the second jet of oxygen-rich oxygenated gas injection orifice. The column 3 paragraph in question indicates that:

- distance $d_2 \geq 5 \times \text{diameter } D$ of secondary oxidizer injector,
- distance $d_2 \geq \text{distance } d_1$, and
- $10 \times \text{diameter } D \leq \text{distance } d_2 \leq 50 \times \text{diameter } D$.

The column 5 paragraph in question indicates that:

- distance $d_2 \geq 5 \times \text{diameter } D$,
- $10 \times \text{diameter } D \leq \text{distance } d_2 \leq 50 \times \text{diameter } D$,
- distance $d_1 \leq 10 \times \text{diameter } d_3$, and
- $D \geq 0.5 \text{ cm}$.

Because no difference between diameters can be deduced from FIG 3, the Examiner’s argument goes as follows:

- IF diameter $D \geq \text{distance } d_2 \text{ divided by } 5$, and
- IF diameter $d_3 \geq \text{diameter } d_1 \text{ divided by } 10$, and
- IF distance $d_2 > d_1$,
- THEN diameter D is greater than d_3 .

Appellants presume that the Examiner relies upon the following derivation:

- if diameter D is $\geq \text{distance } d_2 \text{ divided by } 5$, then D is certainly $> d_1 \text{ divided by } 5$ (as $d_2 > d_1$); and

- because in figure 3, d_2 is at least twice d_1 , it would mean that $d_3 > d_2$ divided by 5.

However, all that one can logically conclude from the underlying facts that $D \geq$ distance d_2 divided by 5 and $d_3 >$ distance d_2 divided by 5 is that:

- if D is equal to d_2 divided by 5, D is smaller than d_3 ; and
- if D is greater than d_2 divided by 5, no conclusion can be drawn about the relative sizes of D and d_3 ; rather, all that is apparent is that both D and d_3 are greater than d_2 divided by 5.

Thus, the Examiner has failed to prove the underlying assumption that D is greater than d_3 , much less that it would have been obvious to the skilled person starting from the primary reference Dugue to make D at least 4 times d_3 through routine experimentation.

Despite the Examiner's failure to show how Dugue discloses the above-recited limitation or why the limitation is a mere design choice, the above-recited limitation (the area of the cross section of the injection orifice for the oxygen-lean oxygenated gas is between 4 and 100 times the area of the injection cross section for the second jet of oxygen-rich oxygenated gas) is still a significant effect and/or critical result for the following reasons.

Combustion methods employing oxygenated gases generally use oxygen coming from continuous oxygen production units, such as a cryogenic unit or a VSA (vacuum swing adsorption) unit. To anticipate the risks of interruption in the supply of oxygen coming from these units, a liquid oxygen reservoir is generally provided near the place where the combustion takes place. To reduce the storage costs of this tank and to avoid storing too large an amount of oxygen, which could classify the combustion site as a high accident risk site, it is generally preferred to reduce the capacity of this storage tank. However, this reduction in storage capacity does not always allow the combustion to be fed for a long enough time during an interruption in supply.

One solution would be to supply the combustion with air, but generally burners employing a gas richer in oxygen than air do not permit the use of a large

flow of air. Without further modification, the air would have to be injected through the nozzle used for injection of the oxygen-rich gas. Because the air contains a larger amount of nitrogen, the air injection would require a higher velocity in order to maintain the same amount of oxygen necessary for combustion with the fuel. A higher velocity would significantly change the flame shape and length. Such changes in the shape and the length of the flame and in the type of combustion are generally undesirable and may lead to changes in heating efficiency, changes in product-quality and damage to the furnace (flame impact and hot spots).

On the other hand, the present invention allows a burner to be operated with air in the event of an interruption in the continuous supply of the oxygen-rich gas that it is usually operated with. By providing an orifice for injecting the oxygen-lean gas (such as air) that is 4 to 100 times larger than the orifice for injection of the second injection of oxygen-rich gas, no drastic increase in velocity is required in order to provide a same amount of oxygen for combustion with the fuel. Thus, the flame shape and heat transfer uniformity are not deleteriously impacted.

2) The Examiner's Rejection Is Not A Successful Showing Under
The Teaching-Suggestion-Motivation (TSM) Test Or Under Other
Rationales Identified By The Supreme Court In KSR V. Teleflex.

It is well established that, if the teachings of references require substantial reconstruction and redesign of the elements shown in a primary reference sought to be modified and change the basic principle under which that primary reference was designed to operate, then those are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 813, 123 USPQ 352 (CCPA 1959).

The Examiner's rejection is not a succesful showing under the TSM test because the modification of Dugue proposed by the Examiner would have required substantial reconstruction and redesign of the elements shown in Dugue as well as changed the basic principle under which Dugue was designed to operate, and also because such modification would have either not resulted in the claimed subject matter.

Dugue discloses a burner in which two portions of primary oxidant 23, 24 and a secondary oxidant 22 are injected from a burner adjacent to an injection of fuel 25. Khinkis discloses substoichiometric combustion of a fuel 11 with an oxygen-rich gas 10 in a cracking chamber 10 followed by combustion of the productions of combustion from the cracking chamber 10 with additional oxidant 22 in a combustion chamber 20.

Without specifying exactly how, the Examiner proposes to modify the operation of the Dugue burner by using oxygen-rich oxygenated gas for the primary sub-stoichiometric combustion in order to putatively provide a furnace with enhanced efficiency and reduced NOx emission as taught by Khinki. However, the enhanced efficiency and reduced NOx emission of Khinkis are achieved not by simply combusting fuel with an oxygen-rich gas under sub-stoichiometric conditions, but by combusting fuel with an oxygen-rich gas under sub-stoichiometric conditions in a cracking chamber followed by passing the products of partial combustion to a subsequent combustion chamber where they are more fully combusted. In order to predictably realize the enhanced efficiency and NOx-lowering effects of Khinkis, the Dugue burner would have to be modified such that: a) no injection of secondary oxidant would occur at the burner, b) the products of incomplete combustion of the fuel and primary oxidant would need to be contained and conveyed to a combustion chamber, and c) the products of incomplete combustion would need to be fully combusted in the separate combustion chamber. This is because both the cracking chamber and the combustion chamber and associated conditions are necessary for achieving the enhanced efficiency and NOx-lowering effects of Khinkis. Such modifications of Dugue would have resulted in a substantial reconstruction and redesign of the Dugue burner and process of operation as well as have changed the basic principle under which the Dugue burner was operated.

Thus, the Examiner's rejection fails the TSM test.

In *KSR v. Teleflex*, the Supreme Court identified seven different rationales that could support a finding of obviousness. The first of these is the TSM test

which Appellant has shown the Examiner's rejection as failing to satisfy. Four of the remaining six are relevant to the instant rejections: (1) combining prior art elements according to known methods to yield predictable results; (2) simple substitution of one known element for another to obtain predictable results; (3) use of a known technique to improve similar devices, methods, or products in the same way; and (4) applying a known technique to a known device, method, or product ready for improvement to yield predictable results. Appellant asserts that none of these four rationales apply because one of ordinary skill in the art would not have considered the Khinkis-taught NO_x-lowering effects identified by the Examiner to be predictable in the hypothetical application to the burner of Dugue in the manner suggested by the Examiner. This is because application of the Khinkis technique of cracking a fuel under sub-stoichiometric conditions in a cracking chamber followed by conveyance of the products of incomplete combustion to a combustion chamber for more full combustion is significantly different than the relatively simply burner of Dugue. Dugue injects each of the fuel, first portion of primary oxidant, second portion of primary oxidant, and secondary oxidant all from the same plane. On the other hand, Khinkis's injection of the secondary oxidant is well displaced in the flame direction from the injection of fuel and primary oxidant. Dugue injects the fuel and oxidant into a combustion space where complete combustion occurs. On the other Khinkis employs two separate chambers: a cracking chamber for incomplete combustion well spaced away in the flame direction from a combustion chamber for complete combustion of the remaining uncombusted fuel. Additionally, one of ordinary skill in the art would readily recognize that, where Khinkis injects the secondary oxidant, there no longer is a jet of fuel.

Thus, the Examiner's rejections fail under KSR rationales other than the TSM test.

3) The Modification Of Dugue With The Teachings Of Khinkis Suggested By The Examiner Would Not Have Resulted In The Claimed Subject Matter.

It is well established that a combination of references cited in an obviousness rejection must teach all of the claim limitations. Notwithstanding Appellants' arguments, even if such modifications had been made to the burner and method of Dugue according to the teachings of Khinkis, it would not have resulted in the claimed subject matter because not all of the claim limitations would have been met. More particularly, the modification of Dugue would have necessarily relocated the injection of the secondary oxidant to the combustion chamber such that the secondary oxidant is injected at an indeterminate distance from the jet of fuel injected at the cracking chamber. In contrast, the claimed subject matter requires that the oxygen-lean oxygenated gas is injected at a distance ℓ_2 from the jet of fuel so as to combust with a second portion of the fuel present in the gases output by the first combustion where $\ell_2 > \ell_1$. The Examiner fails to set forth any teaching in Dugue or Khinkis leading to a conclusion that the injection of secondary oxidant at the combustion chamber downstream of the cracking chamber would necessarily follow this mathematical relationship between the distances ℓ_2 and ℓ_1 .

Thus, regardless of whether the TSM test is applied or some other KSR rationale is applied, the rejection is improperly made.

A) Claim 24 Is Non-Obvious Over Dugue In View Of Khinkis and Koppang.

Because claim 24 depends from claim 16 and the combination of Dugue and Khinkis fail to render claim 16 obvious, the rejection of claim 24 over the combination of Dugue, Khinkis, and Koppang is similarly improper for the above reasons.

CONCLUSION

The Examiner errs in finding that:

- A. Claims 16-21, 23-24 and 29-30 are unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 6,910,879 (Dugue) in view of U.S. Patent No. 4,761,132 (Khinkis).
- B. Claim 24 is unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 6,910,879 (Dugue) in view of U.S. Patent No. 4,761,132 (Khinkis) and further in view of U.S. Patent No. 5,759,022 (Koppang).

Reversal of the Examiner is respectfully requested.

Respectfully submitted,

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8. Claims Appendix

Claims 1 – 15 (cancelled)

Claim 16 (previously presented): A method for the combustion of a fuel using an oxygenated gas, in which a jet of fuel and at least two jets of oxygen-rich oxygenated gas are injected, the first jet of oxygen-rich oxygenated gas, called the primary jet, being injected so as to be in contact with the jet of fuel and so as to generate incomplete first combustion, the gases output by this first combustion still including at least one portion of the fuel, and the second jet of oxygen-rich oxygenated gas being injected at a distance ℓ_1 from the jet of fuel so as to combust with a first portion of the fuel present in the gases output by the first combustion, wherein:

an oxygen-lean oxygenated gas is injected at a distance ℓ_2 from the jet of fuel so as to combust with a second portion of the fuel present in the gases output by the first combustion,

the area of the cross section of the injection orifice for the oxygen-lean oxygenated gas is between 4 and 100 times the area of the injection cross section for the second jet of oxygen-rich oxygenated gas; and

ℓ_2 is greater than ℓ_1 .

Claim 17 (original): The method of claim 16, wherein the oxygen-rich oxygenated gas has an oxygen concentration of greater than 30% by volume.

Claim 18 (original): The method of claim 16, wherein the oxygen-lean oxygenated gas has an oxygen concentration of at most 30% by volume.

Claim 19 (original): The method of claim 16, wherein the distance ℓ_1 is between 5 and 20 cm.

Claim 20 (previously presented): The method of claim 19, wherein the distance ℓ_2 is greater than 30 cm.

Claim 21 (original): The method of claim 16, wherein the quantity of oxygen injected by the jets of oxygen-rich oxygenated gas represents 10 to 50% of the total quantity of oxygen injected.

Claim 22 (canceled)

Claim 23 (original): The method of claim 16, wherein the oxygen-lean oxygenated gas is preheated before being injected.

Claim 24 (original): The method of claim 16, wherein the oxygen-rich oxygenated gas derives at least partly from a liquid oxygen storage unit.

Claim 25 (previously presented): A separate-injection burner assembly consisting of a third block surrounded on each side by a set of blocks comprising, in order, a first block and a second block, in which:

- a) the first block has a fuel injection orifice and at least two oxygenated-gas injection orifices, the first oxygenated-gas injection orifice being placed so as to be in contact with the fuel injection orifice, the second oxygenated-gas injection orifice being placed at a distance ℓ_1 from the fuel injection orifice;
- b) the second block has at least third and fourth oxygenated-gas injection orifices, each placed at a distance ℓ_2 from the fuel injection orifice of the first block, ℓ_2 being greater than ℓ_1 and the fourth oxygenated-gas injection orifice having an area of between 4 and 100 times the area of the third orifice; and

- c) the third block has a fifth oxygenated-gas injection orifice placed at a distance ℓ_2 from the fuel injection orifice and having an area of between 4 and 100 times the area of the third injection orifice.

Claim 26 (original): The burner assembly of claim 25, wherein the first oxygenated-gas injection orifice is placed centrally in the fuel injection orifice.

Claim 27 (canceled)

Claim 28 (canceled)

Claim 29 (original): The use of the method of claim 16 for heating a glass charge or for a reheat furnace.

Claim 30 (original): The use of the method of claim 16 when the continuous production of oxygen is interrupted.

9. Evidence Appendix

None.

10. Related Proceedings Appendix

None.